

# Overview of knowledge economy in the Arab region

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### **Overview of knowledge economy in the Arab region** **Samia Satti Osman Mohamed Nour**

**Maastricht Economic and social Research institute on Innovation and Technology (UNU-MERIT)**  
email: [info@merit.unu.edu](mailto:info@merit.unu.edu) | website: <http://www.merit.unu.edu>

**Maastricht Graduate School of Governance (MGSoG)**  
email: [info-governance@maastrichtuniversity.nl](mailto:info-governance@maastrichtuniversity.nl) | website: <http://mgsog.merit.unu.edu>

Keizer Karelplein 19, 6211 TC Maastricht, The Netherlands  
Tel: (31) (43) 388 4400, Fax: (31) (43) 388 4499

# **Overview of Knowledge Economy in the Arab Region**

**By Dr. Samia Satti Osman Mohamed Nour**

**(January 30, 2013)**

# Overview of Knowledge Economy in the Arab Region

By Dr. Samia Satti Osman Mohamed Nour <sup>1</sup>

(January 30, 2013)

## Abstract

This paper employs both the descriptive and comparative approaches and uses the definition of knowledge and knowledge indicators used in the literature to examine the existence and development of the knowledge economy in the Arab region. We fill the gap in the Arab literature and present a more comprehensive analysis of the development of knowledge indicators in the Arab region. Our findings support the first hypothesis that the knowledge economy exists in the Arab region and coincides with a substantial knowledge gap compared to other world regions. Our results corroborate the second hypothesis concerning the variation in knowledge indicators, according to the structure of the economy in the Arab region, and support the third hypothesis concerning the poor and slow progress in the trend of knowledge – related indicators in the Arab region. Therefore, it is essential for the Arab region to enhance the knowledge economy and indicators to achieve economic development in the Arab region.

**Keywords:** Knowledge economy, tacit knowledge, codified knowledge, knowledge index, Arab region

**JEL classification:** O10, O11, O30

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<sup>1</sup> Corresponding Author: Dr. Samia Satti Osman Mohamed Nour, Affiliated Researcher – UNU-MERIT, School of Business and Economics, University of Maastricht, Maastricht, the Netherlands; and Associate Professor of Economics, Economics Department, Faculty of Economic and Social Studies, Khartoum University, Khartoum, Sudan. E-mail: [samiasatti@yahoo.com](mailto:samiasatti@yahoo.com); [samia\\_satti@hotmail.com](mailto:samia_satti@hotmail.com). The research work presented in this paper is based on a research project supported by a grant offered by the Global Development Network (GDN) Fourth Round Regional Research Grant Competition administered by the Economic Research Forum for the Arab Countries, Iran and Turkey (ERF) in collaboration with Global Development Network (GDN) and a grant offered by the Middle East Research Grant Competition (MERC) (2003-2004) administered by the Center for the Study of Developing Countries (CICS), Faculty of Economics and Political Science, Cairo University, Cairo, Egypt in collaboration with Ford Foundation. The author gratefully acknowledges the ERF, GDN, MERC and Ford Foundation for the research grants. The revised version of this paper was presented at the ERF-GDN Final Workshop of Grantees Projects of ERF-GDN, the ERF 13<sup>th</sup> Annual Conference (2006) on "Oil: Its Impacts on the Global Economy", the Arab Fund for Economic and Social Development, Kuwait, December 15-18, 2006. The first version of this paper was originally presented at the ERF-GDN First Workshop of Grantees Projects of ERF-GDN, the ERF 12<sup>th</sup> Annual Conference (2005), Cairo, Egypt, December 19-21, 2005, and the MERC First Conference Workshop of Scholar's Grantees Projects of MERC, the Center for the Study of Developing Countries (CICS), Faculty of Economics and Political Science, Cairo University, Cairo, Egypt, December 12-18, 2003. The author would like to thank the participants for their useful comments on this paper. All the usual disclaimers apply.

## Overview of Knowledge Economy in the Arab Region

### 1. Introduction

This paper presents an overview of the knowledge economy in the Arab region and contributes to recently published research studies that aim to improve understanding of the development and performance of knowledge economy in the developing countries.<sup>2</sup> This paper addresses the following questions: Does the knowledge economy exist in the Arab region?; Does the economic structure affect the knowledge indicators in the Arab region?; and How important is the development of knowledge indicators in the Arab region?.

We examine three hypotheses, the first hypothesis argues that the knowledge economy exists in the Arab region but coincides with substantial knowledge gap compared to other world regions. This hypothesis implies that the Arab region has manifestly lagged far behind other world regions in terms of indicators related to knowledge economy. We examine the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region. We examine the third hypothesis concerning the stagnation or slow development in the trend of the major knowledge indicators in the Arab region.

We fill the gap in the Arab literature and present a more comprehensive analysis of the incidence and development of knowledge economy in the Arab region. Different from the conventional view in the literature and earlier studies in the Arab literature (Nour, 2011) that use the conventional classification of countries according to income level, an interesting element in our analysis is that we use a different classification based on the structure of the economy to examine the knowledge economy in the Arab region. We believe that the selection of this criterion seems quite consistent with the well known stylized facts and widely used standard classification of Arab countries according to their reliance on natural resources. The selection of this criterion seems sound since the knowledge economy are often linked to both the resources directly devoted to knowledge development and also to the whole economic structure that supports knowledge development. Moreover, we use recent and update data and provide a more updated study compared to a few earlier studies on the knowledge economy in the Arab region (Nour, 2011). We fill the gap in the Arab literature by explaining the relationship between knowledge economy and structure of the economy in the Arab region and the observed knowledge gap in the Arab region. Moreover, we support the efforts aim to enhance knowledge economy and institutions necessary for building knowledge economy in the Arab region. Moreover, we investigate the recent development of knowledge indicators and knowledge economy index in the Arab region compared to other world regions.

Regarding research method, we use the descriptive and comparative methods of analysis. Similar to the studies in the literature, we define knowledge as decomposed of tacit knowledge and codified knowledge. We define tacit knowledge by the percentage share of high skilled people in total population, and we define tacit knowledge by tacit skills, which we define by both enrolment in tertiary education and the number of researchers or full time equivalent researchers (FTER). We define codified knowledge by embodied knowledge distributed in many aspects including total spending on education and R&D. Codified

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<sup>2</sup> The Arab region is composed of twenty two countries, including Algeria, Bahrain, Comoros, Djibouti, Egypt, Iraq, Jordan, Kuwait, Lebanon, Libyan Arab Jamahiriya, Mauritania, Morocco, Oman Occupied Palestine Territories, Qatar, Saudi Arabia, Somalia, Sudan, Syrian Arab Republic, Tunisia, United Arab Emirates and Yemen.

knowledge is calculated as a total of the share of public spending on education and R&D spending as percentage of GDP. In addition we use several variables and many other indicators in relation to the components of knowledge, such as the number of publications and scientific and technical journal articles, patents and average schooling years across Arab countries. Moreover, we use other indicators such as knowledge index and knowledge economy index.

The rest of this paper is organized as follows: Section 2 presents the conceptual framework and literature review. Section 3 shows the general socio-economic characteristics of Arab region. Section 4 discusses existence of knowledge economy in the Arab region compared to the other world regions. Section 5 explains the major development in knowledge economy over the period (1995-2012) in the Arab region. Finally, Section 6 provides the conclusions and policy recommendations.

## **2. Conceptual framework and literature review**

In the recent years the world economy is witnessing a fundamental structural change driven by both globalization and the revolution in information and communication technology (ICT) leading to a new economic system. The new economic system is characterizing by increasing significance of knowledge, the rapid diffusion of ICT, productivity growth and intensified competition and globalization trend. Hence, the role of knowledge have intensified and attracted a great deal of interest at the international level. More recent literature raised a debate on the interaction between these elements and the various influences or opportunities they might create for the new economy for both developed and developing countries.

Knowledge creation, accumulation and acceleration is intensified the pace of scientific and technological progress and has been at the heart of economic growth literature. The ability to invent, innovate and create new knowledge and new ideas that are then either embodied in machines, products, processes and organizations, or disembodied/ codified in blueprints and operating instructions, has motivated the successful transfer of technology and enhanced economic development. The definition of knowledge in the literature is based on the distinction between codified and tacit knowledge (Dasgupta and David, 1994), and between embodied flows of knowledge (knowledge incorporated in to machinery and equipment) and disembodied flows of knowledge (the use of knowledge transmitted through scientific and technical literature, consultancy, education systems, movement of personnel, etc). Often, investment in knowledge refers to public spending on education, training, R&D and ICT. Moreover, in analysing knowledge as specific input to innovative activities, economists on the one hand, view knowledge as a public good generated via R&D activities that generate spillover and thus increasing returns (Romer, 1994; Grossman and Helpman, 1994). On the other hand, modern innovation theory views knowledge creation in a much more diffuse way. For instance, Langlois (2001) argues that: "knowledge, whether tacit or codified, is embodied in institutions and artefacts that make its transfer possible even in the absence of any codification". Moreover, Smith (2002) argues that: "R&D is but one component of knowledge and innovation expenditures, and by no means the largest. Because, R&D data tend to either overemphasize the discovery of new scientific or technical innovations, or to exclude a wide range of activities that involve the creation or use of new knowledge in innovation. Thus, knowledge rests not only on discovery and R&D but also on learning, external environment (network) of the firm, non- R&D expenditures such as training,

market research, design, trial production and tooling up and IPR costs. In addition to capital expenditure, which is a key mode of ‘embodied’ knowledge spillover from the capital good sector to using industries”.

Drucker (1998) argues that “*Knowledge has become the key economic resource and the dominant—and perhaps the only—source of competitive advantage*”. Powell and Snellman (2004) define the knowledge economy as production and services based on knowledge-intensive activities that contribute to an accelerated pace of technical and scientific advance, as well as rapid obsolescence. The key component of a knowledge economy is a greater reliance on intellectual capabilities than on physical inputs or natural resources.<sup>3</sup> Moreover, David and Foray (2001) discuss knowledge-based communities as agents of economic change. They argue that knowledge-based activities emerge when people, supported by information and communication technologies, interact in concrete efforts to co-produce (i.e. create and exchange) new knowledge, new information and communication technologies are intensively used to codify and transmit the new knowledge. Therefore, a knowledge intensive community is one wherein a large proportion of members are involved in the production, reproduction of knowledge. David and Foray (2001) argue that access to the knowledge economy is highly limited and that there are great disparities between countries and social groups. According to the OECD (1996) the term “*knowledge-based economy*” results from a fuller recognition of the role of knowledge and technology in economic growth. Knowledge, as embodied in human beings (as “*human capital*”) and in technology, has always been central to economic development. But only over the last few years has its relative importance been recognised, just as that importance is growing. The OECD economies are more strongly dependent on the production, distribution and use of knowledge than ever before. The OECD economies are increasingly based on knowledge and information.<sup>4</sup>

The World Bank uses Knowledge Index (KI) and Knowledge Economy Index (KEI) to compare knowledge across the world countries. According to the World Bank, the Knowledge Index (KI) measures a country's ability to generate, adopt and diffuse knowledge. This is an indication of overall potential of knowledge development in a given country. Methodologically, the KI is the simple average of the normalized the key variables in three Knowledge Economy pillars – education and human resources, the innovation system and information and communication technology (ICT). The Knowledge Economy Index (KEI) takes into account whether the environment is conducive for knowledge to be used effectively for economic development. It is an aggregate index that represents the overall level of development of a country or region towards the Knowledge Economy. The KEI is calculated based on the average of the normalized performance scores of a country or region on all four pillars related to the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system and ICT. The Economic incentive and institutional regime pillar includes tariff and nontariff barriers, regulatory quality and rule of law. The education and human resources pillar includes average years of schooling, secondary enrolment and tertiary enrolment. The innovation system pillar includes royalty and license fees payments and receipts, patent applications granted by the US Patent and Trademark Office and scientific

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<sup>3</sup> See Powell and Snellman (2004), p. 199.

<sup>4</sup> See OECD (1996), pp. 3, 9.

and technical journal articles. Information and Communication Technology (ICT) pillar includes fixed telephones, mobile and internet users.<sup>5, 6</sup>

According to the World Bank (2011): "the application of knowledge is now recognized to be one of the key sources of growth in the global economy. The term Knowledge Economy (KE) has been coined to reflect this increased importance of knowledge. A knowledge economy is one where organizations and people acquire, create, disseminate, and use knowledge more effectively for greater economic and social development. This 'knowledge revolution' manifests itself in many different ways: there are closer links between science and technology; innovation is more important for economic growth and competitiveness; there is increased importance of education and life-long learning; and more investment is undertaken in intangibles (R&D, software and education) which is even greater than investments in fixed capital. And of course there is the Information and Communication Technologies (ICT) explosion which brings worldwide interdependency and connectivity. Increased importance of knowledge provides great potential for countries to strengthen their economic and social development by providing more efficient ways of producing goods and services and delivering them more effectively and at lower costs to a greater number of people. However, it also raises the danger of a growing 'knowledge divide' [rather than just a 'digital divide'] between advanced countries, who are generating most of this knowledge, and developing countries, many of which are failing to tap the vast and growing stock of knowledge because of their limited awareness, poor economic incentive regimes, and weak institutions. Combined with trade policy liberalization, the knowledge revolution is leading to greater globalization and increased international competition, which is eroding the natural resource and low labour cost advantage of most developing countries. To capitalize on the knowledge revolution to improve their competitiveness and welfare, developing countries need to build on their strengths and carefully plan appropriate investments in human capital, effective institutions, relevant technologies, and innovative and competitive enterprises. Countries such as Korea, Ireland, Malaysia, and Chile illustrate the rapid progress that can be made. Framework for a Knowledge-based Economy consisting of four pillars that help countries articulate strategies for their transition to a knowledge economy: An economic and institutional regime that provides incentives for the efficient use of existing and new knowledge and the flourishing of entrepreneurship. An educated and skilled population that can create, share, and use knowledge well. An efficient innovation system of firms, research centres, universities, think tanks, consultants, and other organizations that can tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new technology. Information and Communication Technologies (ICT) that can facilitate the effective communication, dissemination, and processing of information. Making effective use of knowledge in any country requires developing appropriate policies, institutions, investments, and coordination across the above four functional areas."<sup>7</sup>

Within this framework, the analysis of knowledge economy and their various influences in different economic systems have been an exciting and interesting recent research issues that received increasing interest amongst economists in both developed and developing countries. Few studies in the Arab literature discuss the knowledge economy (cf. UNDP-AHDR, 2003; 2009; UNDP-AKR, 2009, 2010-

<sup>5</sup> See the World Bank- KEI, 2012: <http://siteresources.worldbank.org/INTUNIKAM/Images/KEIindex.jpg>

<sup>6</sup> For the purposes of calculating KI and KEI, each pillar is represented by three key variables, see ([www.worldbank.org](http://www.worldbank.org)):

<sup>7</sup> See the World bank (2011) "Knowledge for Development" accessed January 23, 2013.

<http://web.worldbank.org/WBSITE/EXTERNAL/WBI/WBIPROGRAMS/KFDLP/0,,contentMDK:20269026~menuPK:461205~pagePK:64156158~piPK:64152884~theSitePK:461198,00.html>



2011). The lack of studies particularly addressing the case of the Arab countries is the major motivation behind this study. Therefore, it might be interesting in this paper to fill the gap in the literature by addressing the status and progress of knowledge economy and knowledge-related indicators in the Arab region compared to other world regions.

### 3. General socio-economic characteristics of the Arab region

Based on the above framework and before examining the existence and development of knowledge economy in the Arab region, in this section it is useful to begin with the general socio-economic characteristics of Arab region Table 1 shows the general socio-economic and development characteristics of the Arab region and world regions as measured by (economic growth (GNI per capita), life expectancy, mean years of schooling, literacy rate and gross enrolment ratios. Table 1 illustrates the substantial gap between Arab and other world regions in terms of population, standard of economic development as measured by GDP per capita and human development index. In general, the Arab region is characterised by low standards of economic development together with high population numbers. According to the World Bank classification of economies, the majority of the Arab countries are classified among medium-income economies. In addition, according to the classification of the UNDP HDI, the average GDP per capita for the Arab region is classified among the world medium-income group and is, on average, lower than for those of the other world regions. Furthermore, the other HDI components: average life expectancy, mean years of schooling, expected years of schooling, literacy rate and gross enrolment ratios for the Arab region on average, lower than for those of the world countries. Moreover, the Arab region is comparable to other developing countries and regions in terms of the widespread and high rates of both unemployment and poverty. This general socio-economic development characteristics of the Arab region has serious implication on the development of knowledge economy and indicators as we explain in the next section.

Table 1- General socio-economic characteristics of the Arab region compared to other world regions (2001-2011)<sup>8</sup>

	Population Total (millions)	GDP per capita (PPP US\$)	Human Development Index (HDI) Value	Life expectancy at birth (years)	Mean years of schooling (years)	Expected years of schooling (years)	Adult Literacy rate (% ages 15 and older)	Gross enrolment ratio		
	2011	2009	2011	2011	2011	2011	2005–2010	Primary (%) 2001– 2010	Secondary (%) 2001– 2010	Tertiary (%) 2001– 2010
<b>Human Development Index groups</b>										
Very high human development	1,129.50	35,768	0.889	80	11.3	15.9	..	102.7	99.7	72.9
High human development	972.9	12,861	0.741	73.1	8.5	13.6	93.2	110.3	90.4	49.3
Medium human development	3,545.50	5,077	0.63	69.7	6.3	11.2	81.9	113.3	69.7	20.5
Low human development	1,259.70	1,671	0.456	58.7	4.2	8.3	59.8	96.5	35	6.2
<b>Regions</b>										
Arab States	360.7	8,256	0.641	70.5	5.9	10.2	72.9	95	66.5	25.8
East Asia and the Pacific	1,978.50	6,227	0.671	72.4	7.2	11.7	93.5	112.3	76.9	24.9
Europe and Central Asia	480.5	14,244	0.751	71.3	9.7	13.4	98	98.5	90.7	57.1
Latin America and the Caribbean	591.2	10,739	0.731	74.4	7.8	13.6	91	116.8	90.7	42.7
South Asia	1,728.50	3,368	0.548	65.9	4.6	9.8	62.8	109.8	55.9	13.1
Sub-Saharan Africa	877.6	2,181	0.463	54.4	4.5	9.2	61.6	100.2	35.3	5.9
Least developed countries	851.1	1,379	0.439	59.1	3.7	8.3	59.2	99.6	35.6	5.7
Small island developing states	53.2	5,241	0.64	69.6	7.3	10.8	..	95.1	76.9	51.6
World	6,974.00	10,715	0.682	69.8	7.4	11.3	80.9	106.9	68.4	27.6

Source: UNDP (2011), PPP – purchasing power parity.

<sup>8</sup> The World Bank and United Nations Development Programme (UNDP) Human Development Report classify world countries differently according to income level. We use the World Bank classification of economies that puts the majority of the Arab countries in the middle-income and low-income categories or groups of economies.

Despite, the great heterogeneity in economic and development indicators/performance across the Arab countries, it is evident that none of the Arab country presents a sufficient, coherent and convincing performance in terms of knowledge economy. While, the rich Arab Gulf oil economies are leading the Arab states in terms of GDP per capita, human development indicators, spending and diffusion of ICT. They fail to present a coherent and convincing performance in terms of knowledge economy due to unpredictable and volatile trend in growth rates coupled with increasing unemployment, insignificant economic impacts of ICT<sup>9</sup> and failure to attract FDI, to promote efficient educational system, local technological capabilities, skills and heavy dependence on foreign technologies.<sup>10</sup>

#### **4. The existence of knowledge economy and development of knowledge –related indicators in the Arab region<sup>11</sup>**

Based on the above background this section discusses the research questions and hypotheses concerning the existence of knowledge economy and development of knowledge –related indicators in the Arab region. First we discuss the existence of knowledge economy in the Arab region; next we investigate the development of knowledge –related indicators in the Arab region using the definition of tacit and codified sources of knowledge. We define tacit sources of knowledge by tacit skills, which we define by the percentage share of high skilled people in total population, enrolment in tertiary education and the number of researchers or full time equivalent researchers (FTER). We define codified sources of knowledge by embodied knowledge distributed in many aspects including spending on education and R&D that measured by the share of public spending on education and R&D as percentage of GDP. In addition we use other knowledge related indicators, such as the literacy rate, average schooling years, the number of publications and scientific and technical journal articles and patents across Arab countries. Moreover, we use other indicators, particularly, the World Bank knowledge index and knowledge economy index.

##### *4.1. Tacit knowledge:*

Starting with tacit sources of knowledge, Table 1 illustrates the substantial gap between Arab region and world regions in terms of several indicators related to tacit knowledge such as gross enrolment ratios in primary, secondary and tertiary education; mean years of schooling and literacy rate. We observe that the literacy rates have been insufficient for the spread of knowledge within the Arab region, for instance, Figure 1 illustrates that despite the relative increase in literacy rates, however, the illiterate population is accounting for 13 per cent of total Arab population in 2011. The illiteracy rates for the Arab region remain higher than the World rate, LCD's, Asia, Latin America and the Caribbean and seem comparable to those of Africa and Sub-Saharan Africa. The shortage and gap related to tacit sources of knowledge also appears in terms of the population with at least secondary education, for instance, the share of population with at least secondary education in total population (per cent of ages 25 and older) represents only 38.4 per cent in the Arab region, compared to 65.1 per cent in Europe and Central Asia and 73.8 per cent in OECD, this result implies substantial gap in tacit sources of knowledge between Arab region and developed world regions- see Figure 2. The shortage and gap between the Arab region and advanced world countries in tacit

<sup>9</sup> See Nour (2002b) and Pohjola (2002) and Kenny (2002) for evidences of insignificant impacts of ICT in developing countries.

<sup>10</sup> See, for example, Muysken and Nour (2006).

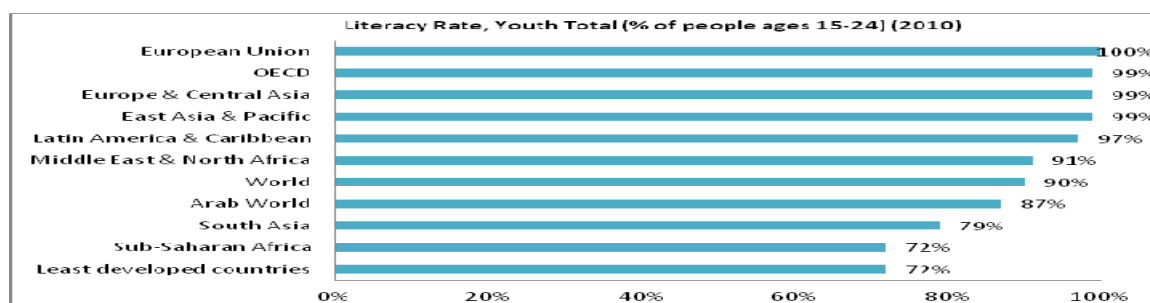
<sup>11</sup> See, for example, Qasem (1998), Zahlan (1999) and Fergany (1999).

sources of knowledge also appears in terms of educational attainment levels (per cent of the population aged 25 and above) (2000–2007). For instance, in the Arab region the share of population with high education attainment represents only 10 per cent of Arab population, while the majority (90 per cent) of Arab population possesses either medium or low educational attainment, particularly, near to three quarter of Arab population possesses low educational attainment- see Figure 3. The gap in tacit sources of knowledge between the Arab and world regions also appears in terms of tertiary education gross enrolment ratio (per cent) over the period (2008-2011). For instance, in 2011, tertiary education gross enrolment ratio (per cent) in the Arab region is only 23.11 per cent falls behind the standard rates of tertiary education gross enrolment ratio (per cent) in the OECD, European Union, Europe and Central Asia, Latin America and Caribbean, MENA countries, World, and the East Asia and the Pacific, which account for 66.59 per cent, 61.4 per cent, 58.33 per cent, 40.54 per cent, 30.55 per cent, 29.11 per cent, and 28.99 per cent of respectively- see Figures 4-5 below. This result concerning the gap in tacit sources of knowledge that appears in terms of tertiary education gross enrolment ratio is consistent with the earlier results in the Arab literature that find that on average the share of gross enrolment ratio in tertiary education, the share of tertiary students in science, math and engineering, school life expectancy and average skill indices measured by Harbison Myers index, technical enrolment index and engineering enrolment index for the Arab region imply that the Arab region is lacking sufficient tacit knowledge and skills and is lagging far behind not only advanced countries but also developing countries. (cf. Nour, 2011).<sup>12</sup> The gap in tacit knowledge between the Arab region and advanced world countries also appears from the number of total researchers, FTER, and total researchers per million inhabitants- see Figures 6-7. These results support part of our first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions.

Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge related indicators. The poor progress in indicators related to tacit sources of knowledge in the Arab region appears from the observed poor progress and increasing trend in terms of gross enrolment in tertiary education over the period (2008-2011) and total number of researchers in R&D (per million inhabitants) over the period (2002-2007). And the declining trend in terms of total number of researchers in R&D (per million people) over the period (2000-2009). These results support part of our third hypotheses concerning the poor and slow progress in the trend of the knowledge – related indicators in the Arab region

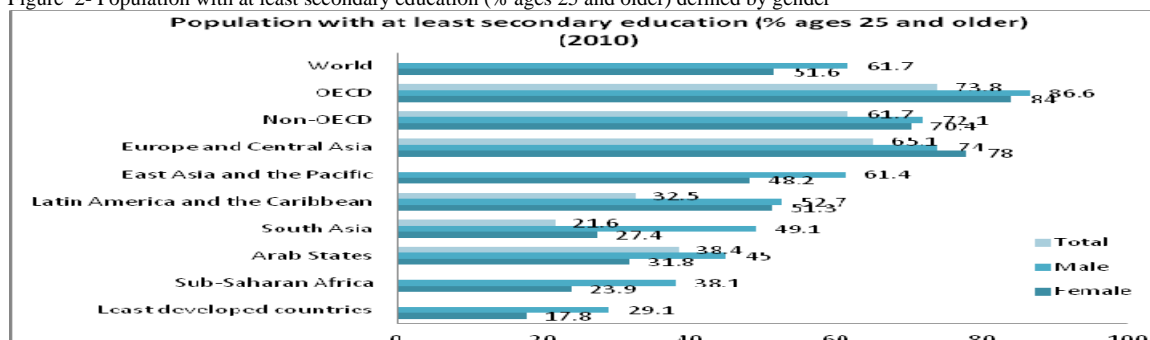
Figure 1- Literacy rate, youth total (per cent of people ages 15-24)

<sup>12</sup> Harbison Myers Index is sum of secondary enrolment and tertiary enrolment times 5, both as % of age group. Technical enrolment index is tertiary total enrolment (times 1000) plus tertiary enrolment in technical subjects (times 5000), both as % of population, Engineering skills index is the same as previous index, with tertiary enrolments in engineering instead of enrolment in technical subjects.



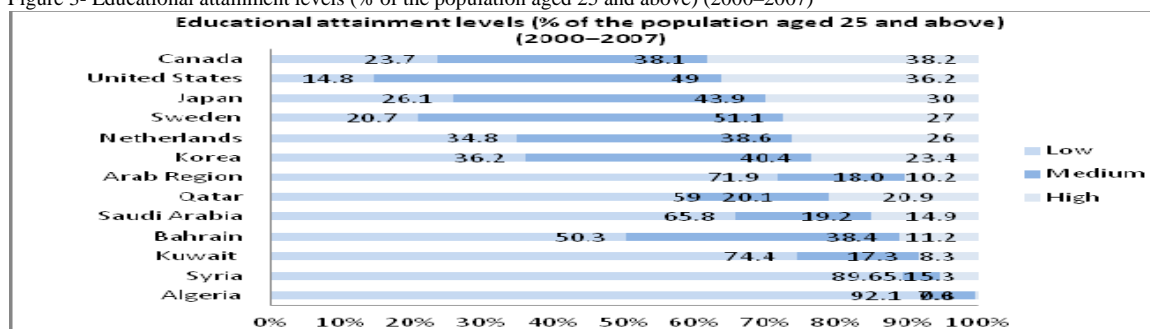
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 2- Population with at least secondary education (% ages 25 and older) defined by gender



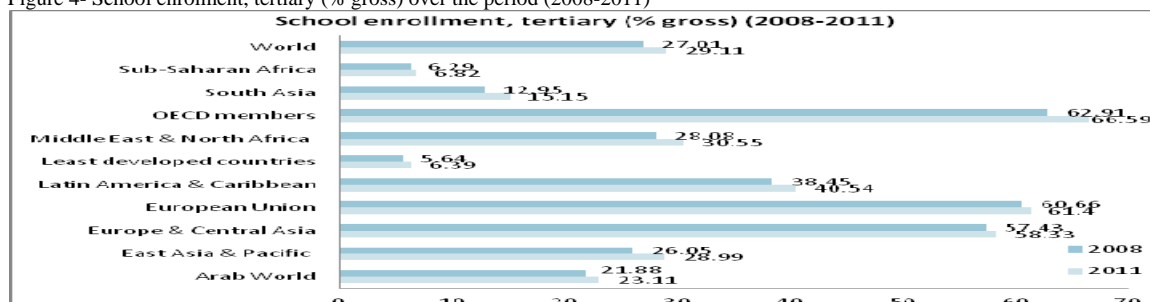
Source: Adapted from UNDP Human Development Report 2010, pp. 160, 196.

Figure 3- Educational attainment levels (% of the population aged 25 and above) (2000–2007)



Source: Adapted from UNDP Human Development Report 2009 - pp. 199-200

Figure 4- School enrolment, tertiary (% gross) over the period (2008-2011)



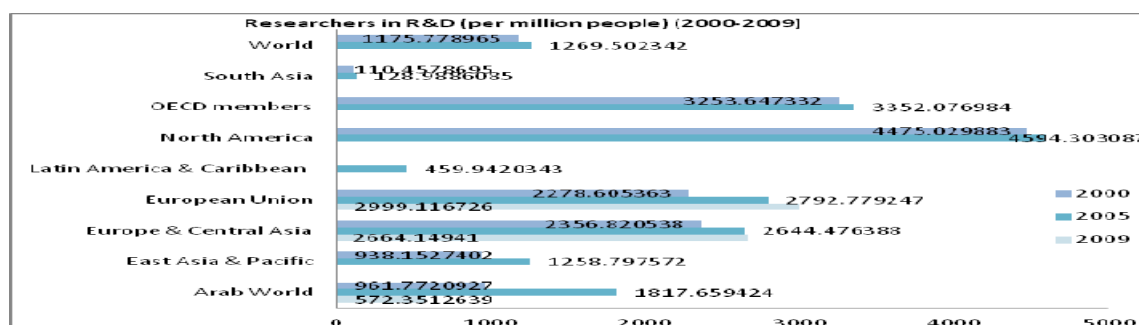
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 5- School enrolment, tertiary (% gross) over the period (2008-2011)



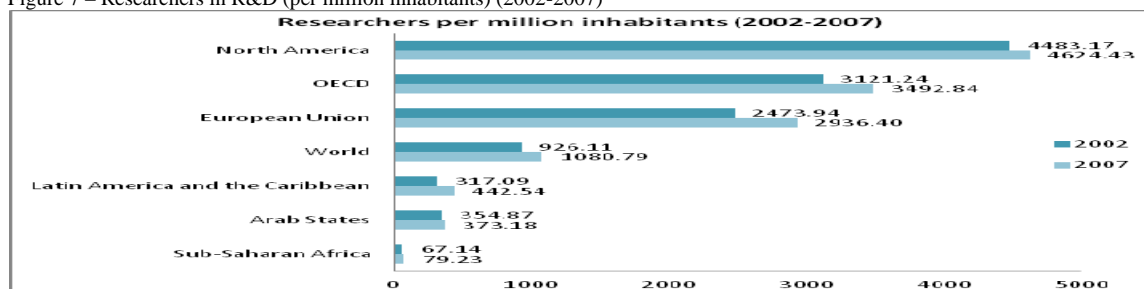
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 6- Researchers in R&D (per million people) (2000-2009)



Source: Adapted from UNESCO Institute for Statistics (2012)

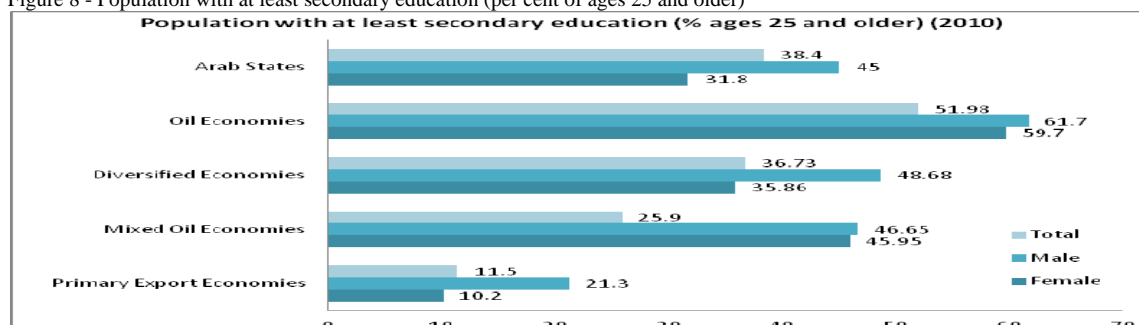
Figure 7 – Researchers in R&D (per million inhabitants) (2002-2007)



Source: Adapted from UNESCO Institute for Statistics (2012)

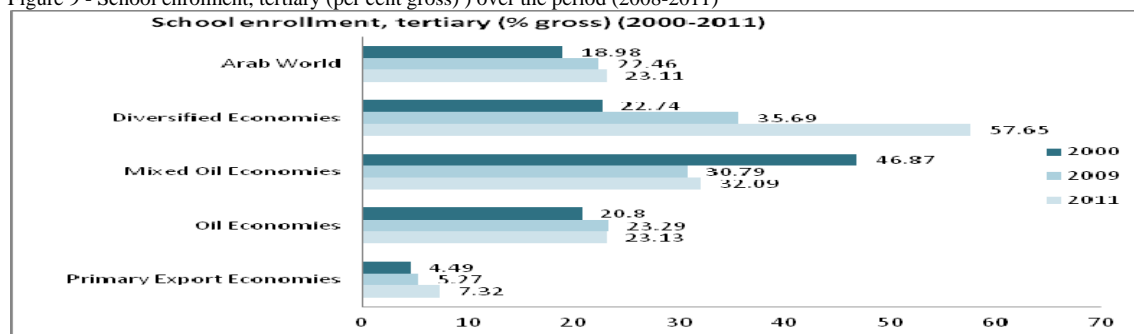
We find that the knowledge indicators show considerable variation across the Arab countries based on the classification according to the structure of the economy. For instance, the variation in tacit sources of knowledge appears in terms of the share of population with at least secondary education in total population that account for 38.4 per cent; 51.98 per cent; 36.73 per cent; 25.9 per cent and 11.5 per cent for all Arab states, oil economies, diversified economies, mixed oil economies and primary export economies respectively. Moreover, the share of population with at least secondary education in total population (per cent of ages 25 and older) defined by gender imply that the share of population with at least secondary education in total population represents only 45 per cent for males and 31.8 per cent for females. These results imply the existence of critical gap in tacit sources of knowledge across the Arab countries and critical gender gap in tacit sources of knowledge in the Arab region. Differences in tacit sources of knowledge across the Arab countries also appear in terms of tertiary education gross enrolment ratio over the period (2008-2011) and number of researchers in R&D (per million people) over the period (2000-2009). For instance, tertiary education gross enrolment ratio in 2011, account for 23.11 per cent; 57.65 per cent; 32.09 per cent; 23.13 per cent and 7.32 per cent for all Arab states, diversified economies, mixed oil economies, oil economies and primary export economies respectively- see Figures 8-11. These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

Figure 8 - Population with at least secondary education (per cent of ages 25 and older)



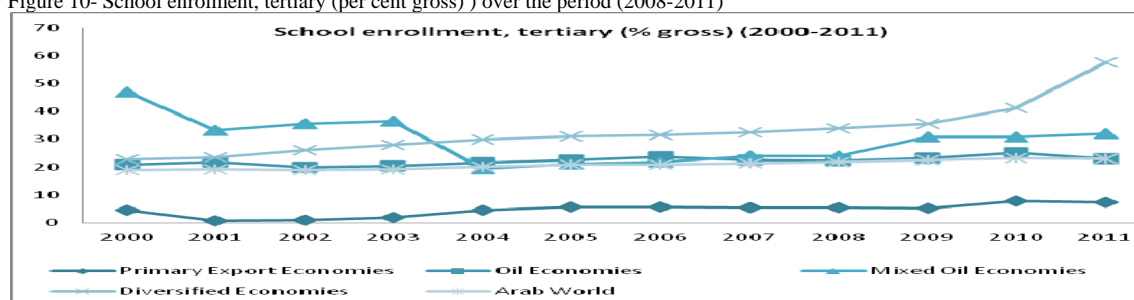
Source: Adapted from UNDP Human Development Report 2010, pp. 156-159, 192-195.

Figure 9 - School enrolment, tertiary (per cent gross) over the period (2008-2011)



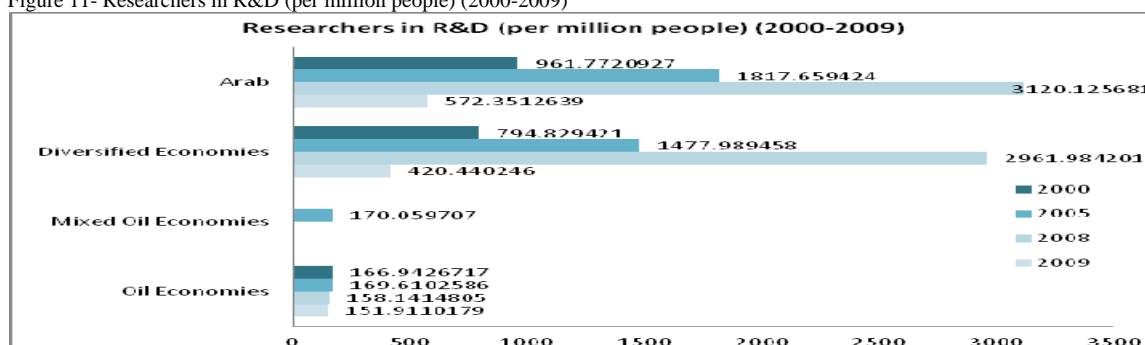
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 10- School enrolment, tertiary (per cent gross) over the period (2008-2011)



Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 11- Researchers in R&D (per million people) (2000-2009)



Source: Adapted from UNESCO Institute for Statistics (2012)

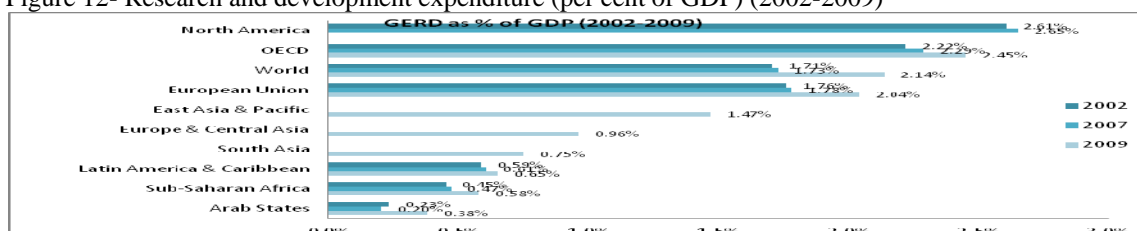
### 3. 2. Codified knowledge:

The knowledge gap also appears in many indicators related to codified sources of knowledge which is embodied knowledge distributed in many aspects including spending on education and R&D can be measured by the share of public spending on education and the share of public spending on R&D as percentage of GDP and GERD. For instance, Figure 12 shows that the share of public spending on R&D as percentage of GDP for all Arab countries together is accounting only for 0.38 of GDP. Indicating that the Arab region is lagging far behind the comparable range of the other world regions and the advanced countries, and even behind those of the developing countries. Knowledge gap in codified sources of knowledge also appears in terms of public spending on education, for instance, while the share of public spending on education as percentage of government expenditure seem comparable and near to the standard of the world region, however, the share of public spending on education as percentage of GDP is lagging behind and near to a half the standard of the world region. These results imply that the Arab region is lacking sufficient spending on indicators necessary for the promotion of codified sources of knowledge, and therefore show substantial gap in terms of codified sources of knowledge, mainly measured by the share of public spending on education and the share of public spending on R&D as percentage of GDP and

GERD over the period (2002-2009)- see Figures 12-14. These results support part of our first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions.

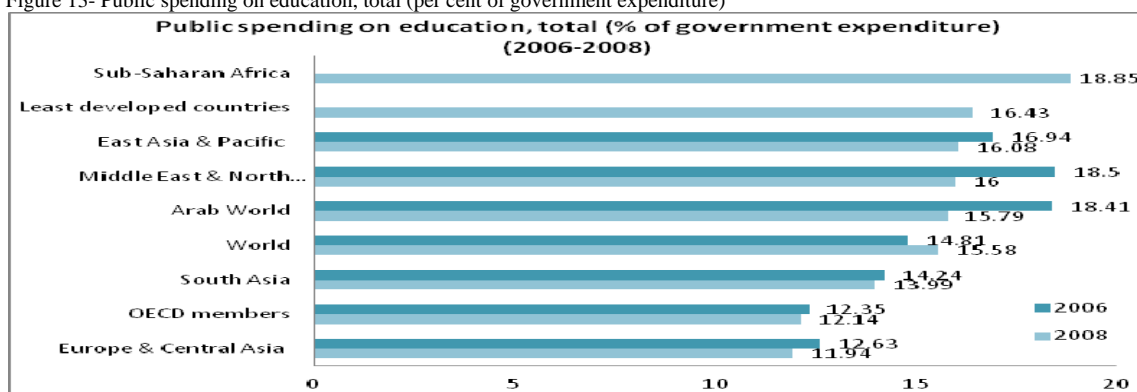
Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge related indicators. The poor progress in indicators related to codified sources of knowledge in the Arab region appears from the observed poor progress and increasing trend in terms of the share of public spending on education as percentage of GDP over the period (2008-2009) and the share of public spending on R&D as percentage of GDP and GERD over the period (2002-2009). And even the declining trend in terms of the share of public spending on education as percentage of government expenditure over the period (2006-2008)- see Figures 12-14. These results support part of our third hypotheses concerning the poor and slow progress in the trend of the knowledge – related indicators in the Arab region

Figure 12- Research and development expenditure (per cent of GDP) (2002-2009)



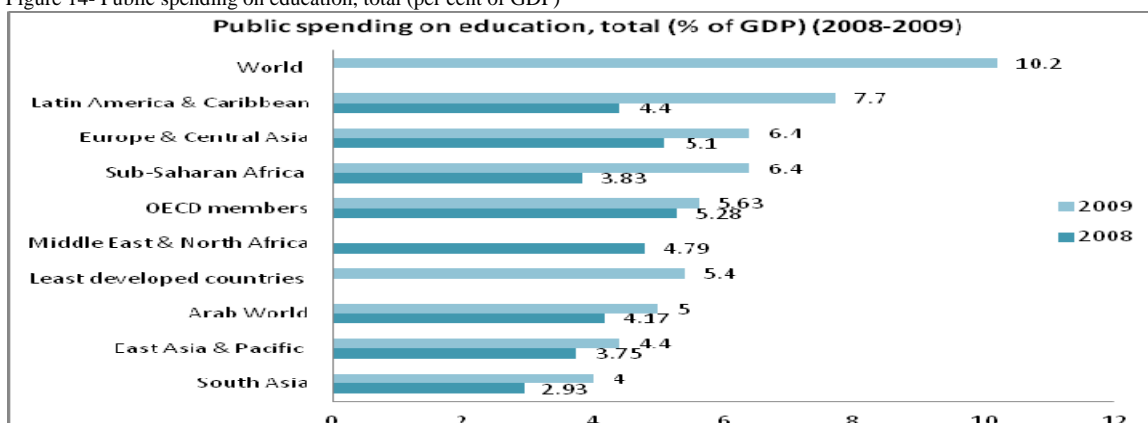
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 13- Public spending on education, total (per cent of government expenditure)



Source: Adapted from UNESCO Institute for Statistics (2012)

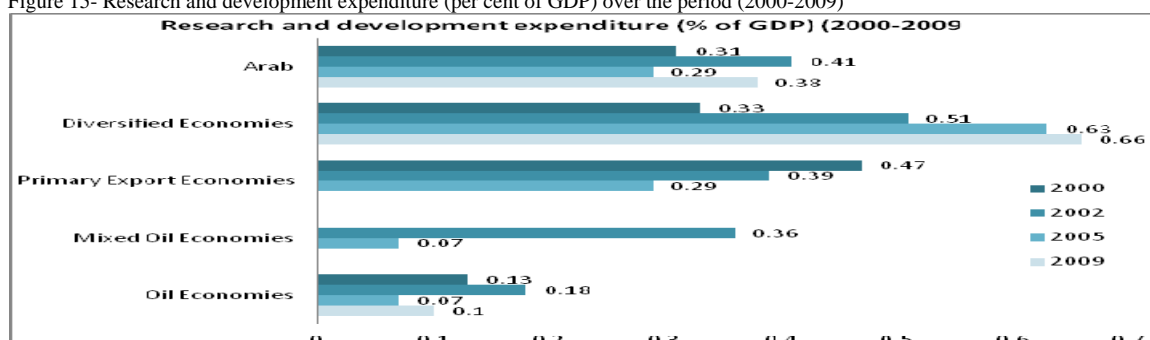
Figure 14- Public spending on education, total (per cent of GDP)



Sources: Adapted from (a) UNESCO Institute for Statistics (2012), (b) UNDP Human Development Report 2011, p. 165.

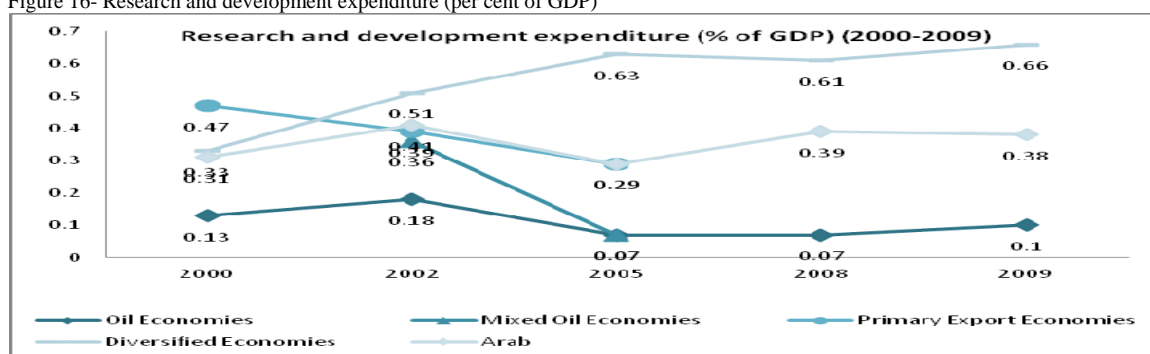
Differences in codified sources of knowledge across the Arab countries also appear in terms of public spending on education over the period (2006-2009) and the share of public spending on R&D as percentage of GDP and GERD over the period (2000-2009). For instance, the share of public spending on R&D as percentage of GDP and GERD in 2009, account for 0.38 per cent; 0.66 per cent; 0.1 per cent; 0. per cent and 0. per cent for all Arab states, diversified economies, oil economies, mixed oil economies, and primary export economies respectively. The share of public spending on education as percentage of GDP in 2009, account for 4.17 per cent; 6.38 per cent; 4.34 per cent; 4.32 per cent; and 3.59 per cent for all Arab states, primary export economies, mixed oil economies, oil economies and diversified economies, respectively. The share of public spending on education as percentage of government expenditure in 2009, account for 15.79 per cent; 20.27 per cent; 17.11 per cent; 15.79 per cent and 12.7 per cent for all Arab states, mixed oil economies, diversified economies, primary export economies and oil economies, respectively - see Figures 15-18. These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

Figure 15- Research and development expenditure (per cent of GDP) over the period (2000-2009)



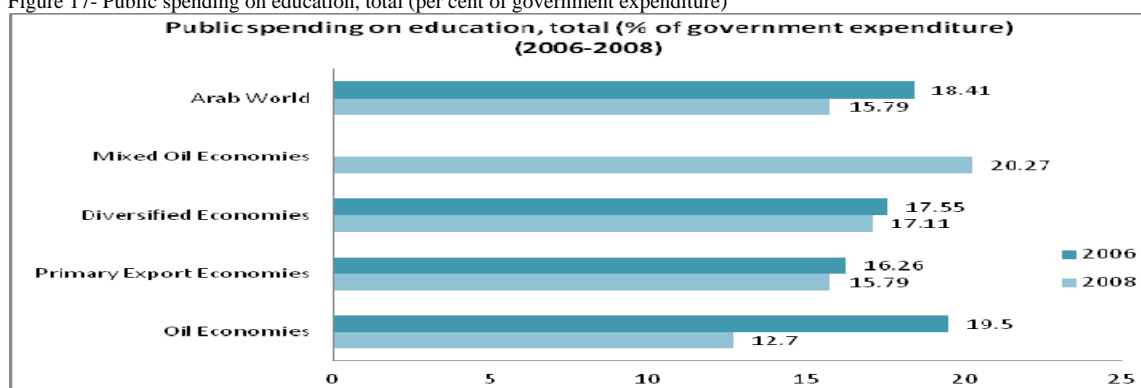
Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 16- Research and development expenditure (per cent of GDP)



Source: Adapted from UNESCO Institute for Statistics (2012)

Figure 17- Public spending on education, total (per cent of government expenditure)



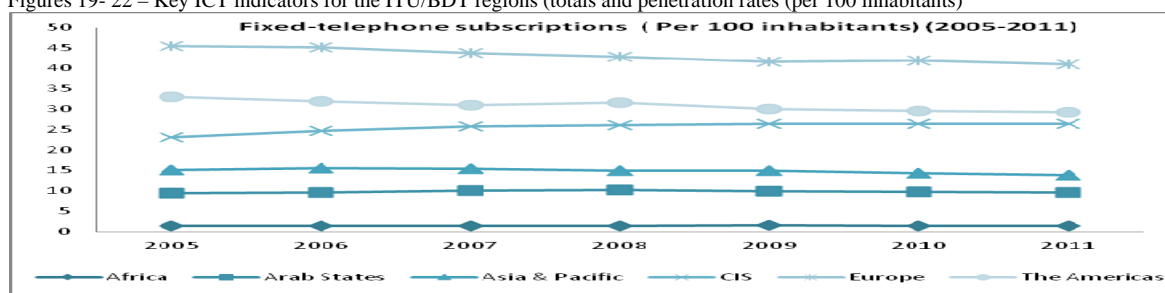
Source: Adapted from UNESCO Institute for Statistics (2012)

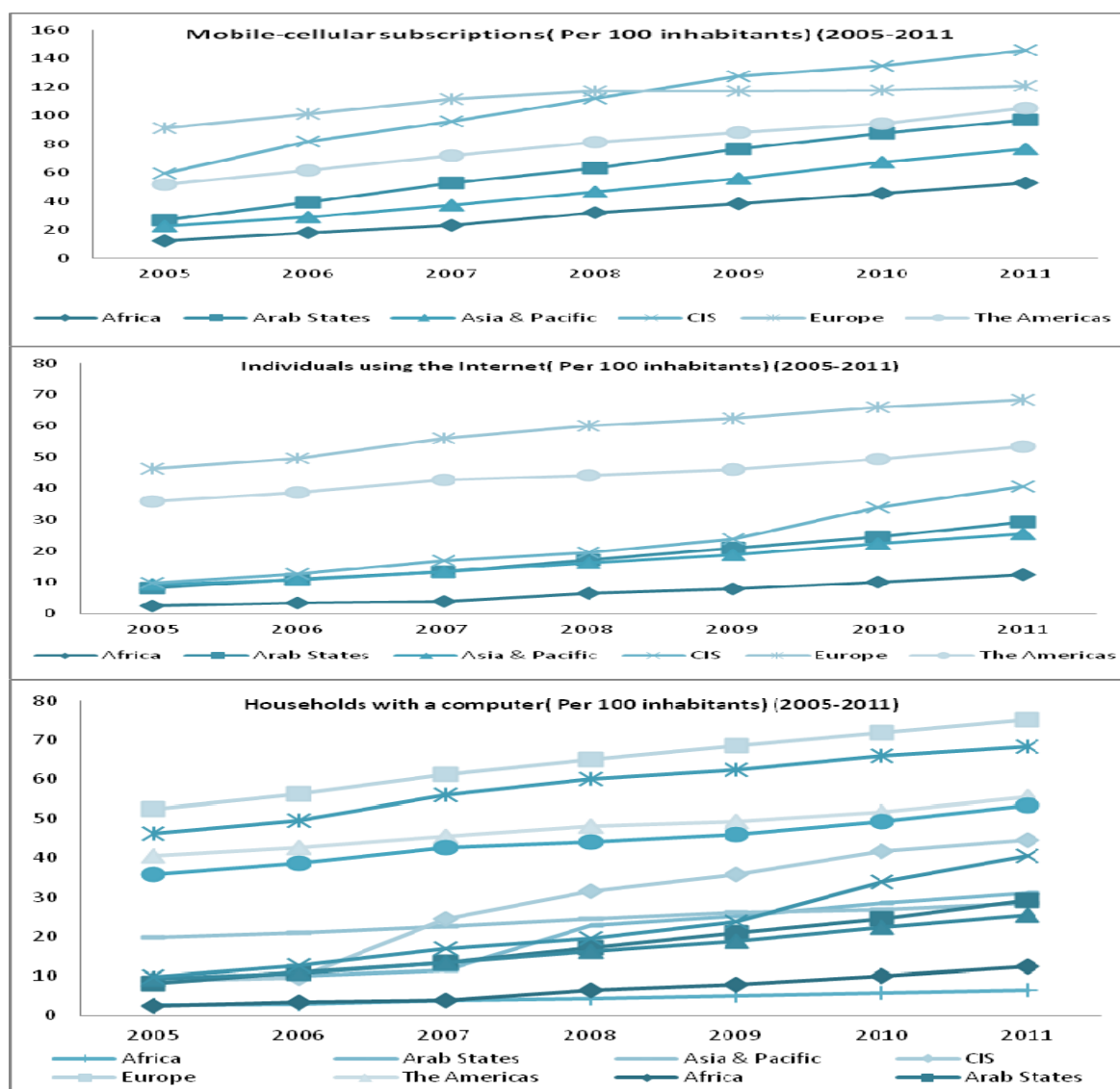
Figure 18- Public spending on education, total (per cent of GDP)





Figures 19- 22 – Key ICT indicators for the ITU/BDT regions (totals and penetration rates (per 100 inhabitants))



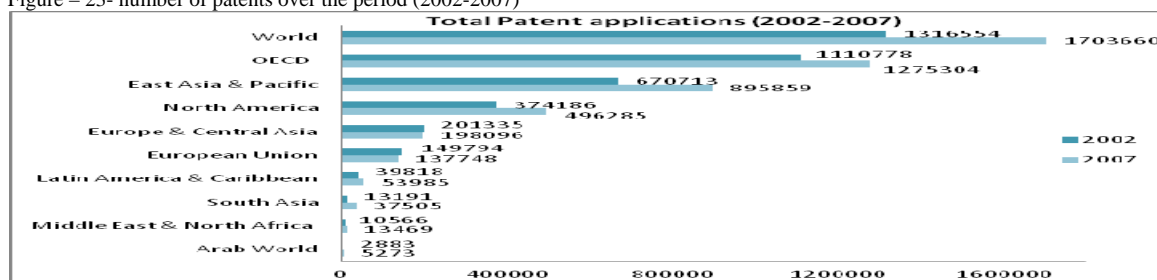


Source: Adapted from International Telecommunication Union, 2012. Accessed 16 January 2013

The incidence of knowledge gap between Arab region and world regions appears also in terms of number of patents awarded to firms and individuals and the total number of scientific and technical journal articles as the total numbers for some of the Arab countries fall far below the total of the World, OECD, East Asia and the Pacific, North America, Europe and Central Asia, European Union, Latin America and Caribbean, South Asia, and MENA countries. The low patenting activities indicate low innovative activities and shortage in knowledge related indicators in the Arab countries compared to advanced countries and developing countries. Concerning the development of knowledge indicators in the Arab region, we find that the incidence of knowledge economy in the Arab region not only coincides with substantial knowledge gap compared to other world regions but also limited progress in knowledge related indicators. The poor progress in indicators related to knowledge in the Arab region appears from low progress and increasing trend in terms of scientific and technical journal articles over the period (2000-2009) and patents over the period (2002-2007) - see Figures 23-25. Differences in knowledge related indicators across the Arab countries also appear in terms of the total scientific and technical journal articles over the period (2000-

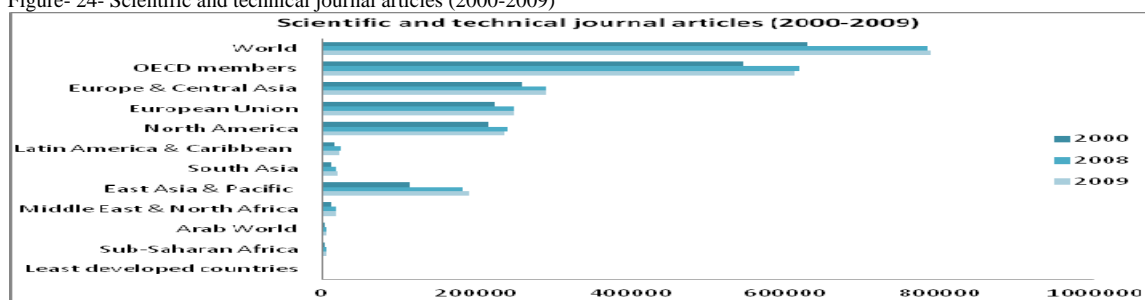
2009), which is higher for the diversified economies followed by oil economies, mixed oil economies and primary export economies respectively- see Figures 26-27.

Figure – 23- number of patents over the period (2002-2007)



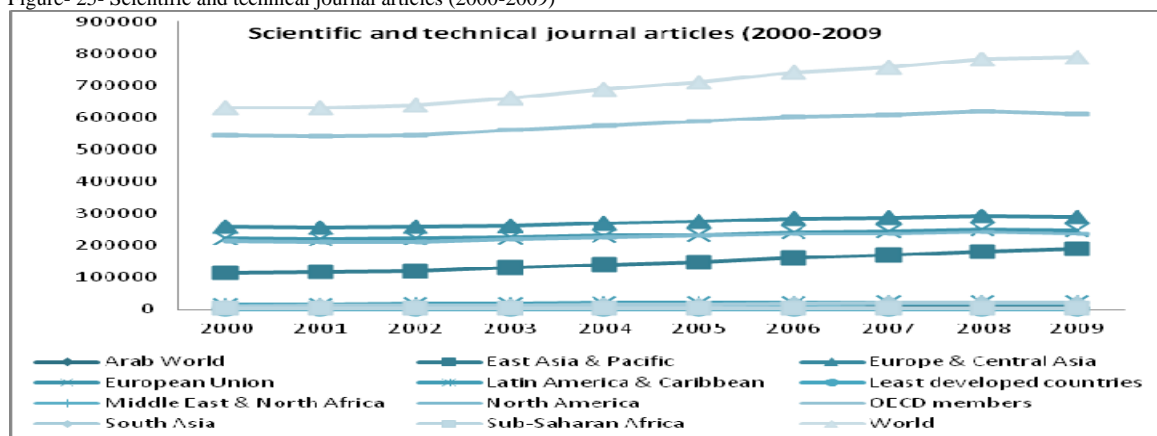
Source: Adapted from World Intellectual Property Organization (WIPO), World Intellectual Property Indicators

Figure- 24- Scientific and technical journal articles (2000-2009)



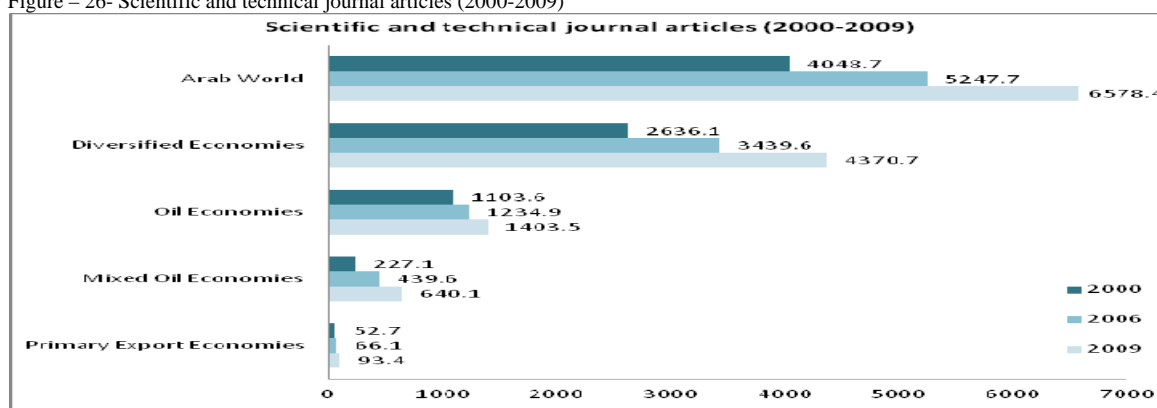
Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

Figure- 25- Scientific and technical journal articles (2000-2009)



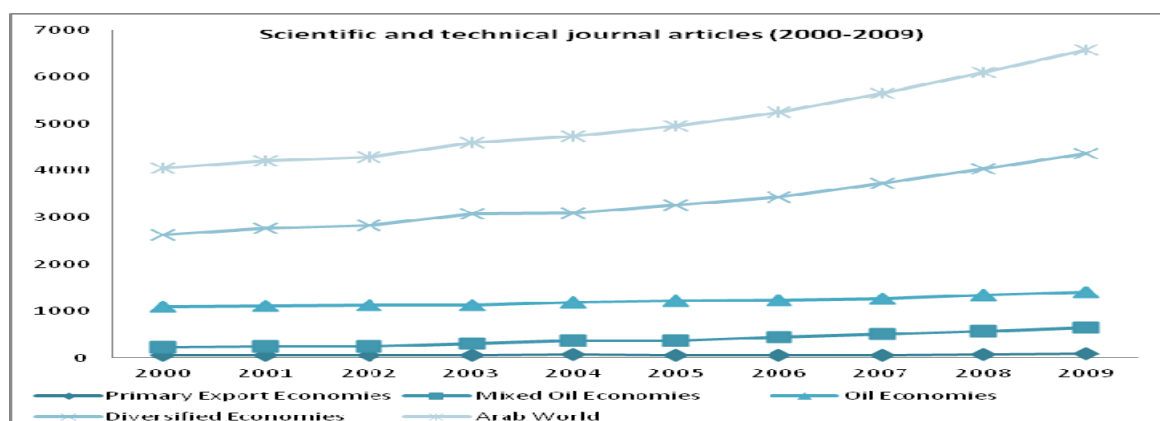
Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

Figure – 26- Scientific and technical journal articles (2000-2009)



Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

Figure 27- Scientific and technical journal articles (2000-2009)



Source: Adapted from National Science Foundation, Science and Engineering Indicators (2012)

#### 4.3. Knowledge Index (KI) and the Knowledge Economy Index (KEI)

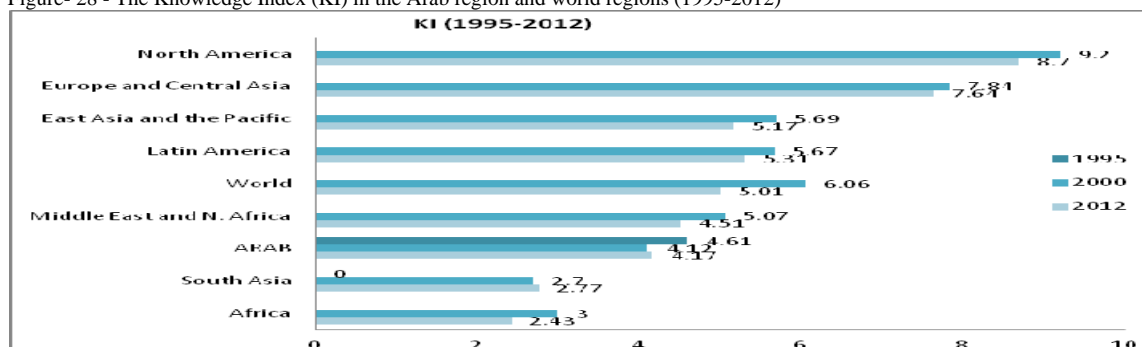
The knowledge gap and shortage of knowledge also appears from the World Bank Knowledge Index (KI) and the Knowledge Economy index (KEI) index over the period (1995-2012). The poor performance of the Arab region in terms of Knowledge Index (KI) and Knowledge Economy Index (KEI), mainly, the Knowledge Index (KI) implies the limited ability of the Arab region to generate, adopt and diffuse knowledge. This is an indication of overall poor potential of knowledge development in the Arab region. The poor KI reflects the poorness with respect to the key variables in three Knowledge Economy pillars – education and human resources, the innovation system and information and communication technology (ICT). The poor performance in terms of Knowledge Economy Index (KEI) implies that the environment is not conducive for knowledge to be used effectively for economic development and this reflects the constraint in the overall level of development of the Arab region that hinders the movement towards the Knowledge Economy. The KEI reflects the poor performance of the Arab region on all four pillars related to the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system and ICT- see Figures 28-34.<sup>13</sup> The declining trends over the period (1995-2012) and small increasing trend over the period (2000-2012) imply poor performance of both the Knowledge Economy Index (KEI) and Knowledge Index (KI). Both the economic incentive and institutional regime and education show small increasing trend over the period (1995-2012). Both innovation and ICT show small decreasing trend over the period (1995-2012), they show declining trend over the period (1995-2000) that turned into small increasing trend over the period (2000-2012) – see Figures 35-36. These results support part of our first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions. These results also support part of our third hypotheses concerning the poor and slow progress in the trend of the knowledge – related indicators in the Arab region

Differences in knowledge related indicators across the Arab countries also appear in terms of Knowledge Economy Index (KEI) and Knowledge Index (KI) and all four pillars related to the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system and ICT- over the period (1995-2012), which are higher for the oil economies followed by the diversified economies, mixed oil economies and primary export economies respectively- see Figures 37-44.

<sup>13</sup> For the purposes of calculating KI and KEI, each pillar is represented by three key variables ([more on these variables](#)):

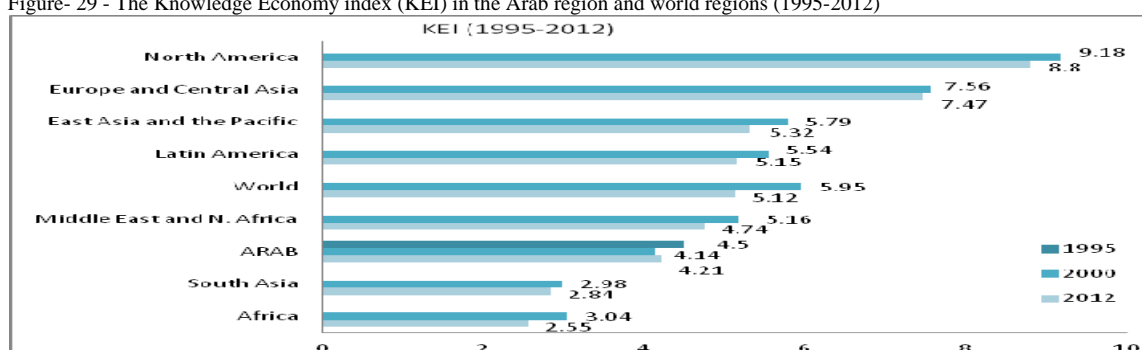
These results support the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region.

Figure- 28 - The Knowledge Index (KI) in the Arab region and world regions (1995-2012)



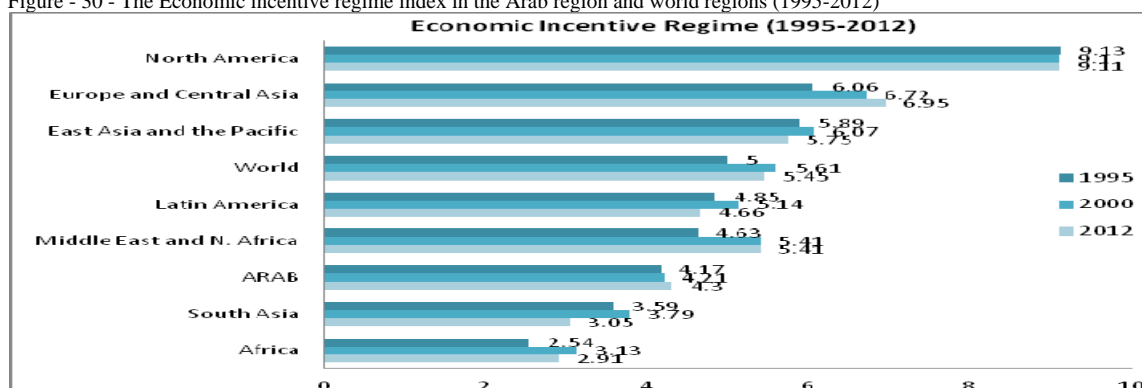
Source: Adapted from the World Bank (2012)

Figure- 29 - The Knowledge Economy index (KEI) in the Arab region and world regions (1995-2012)



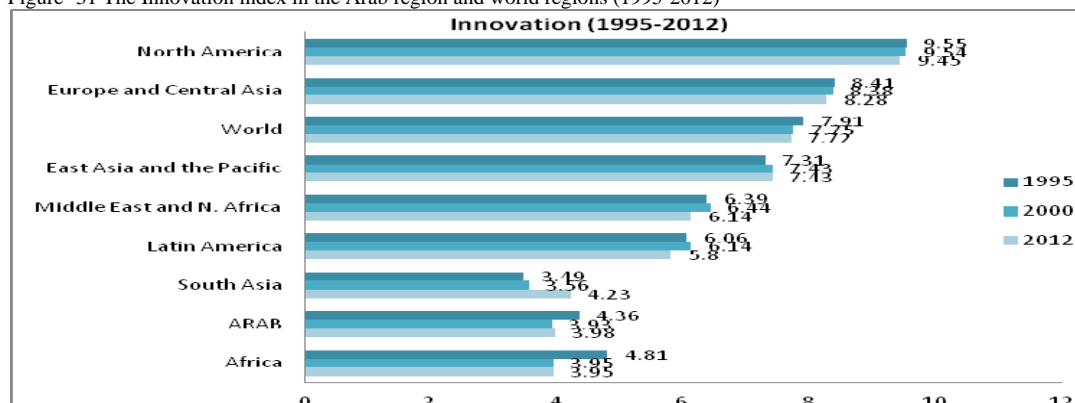
Source: Adapted from the World Bank (2012)

Figure - 30 - The Economic incentive regime index in the Arab region and world regions (1995-2012)



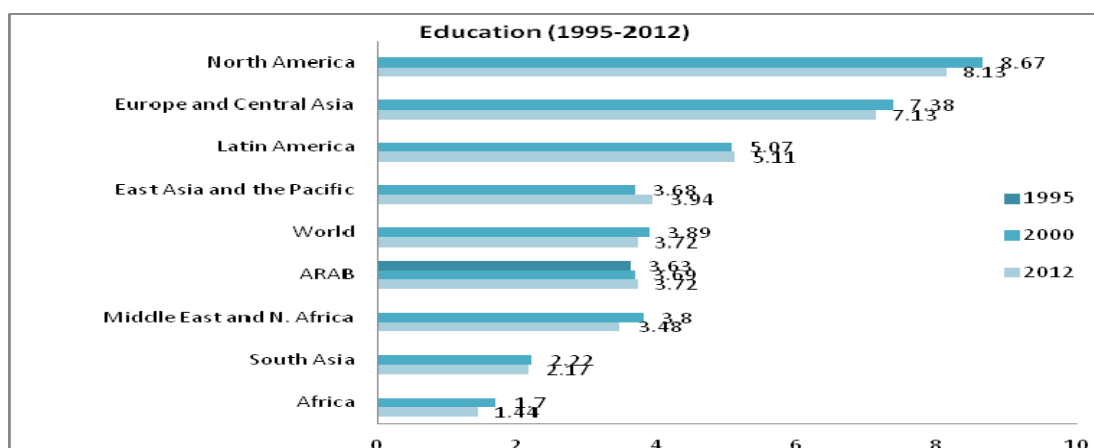
Source: Adapted from the World Bank (2012)

Figure- 31 The Innovation index in the Arab region and world regions (1995-2012)



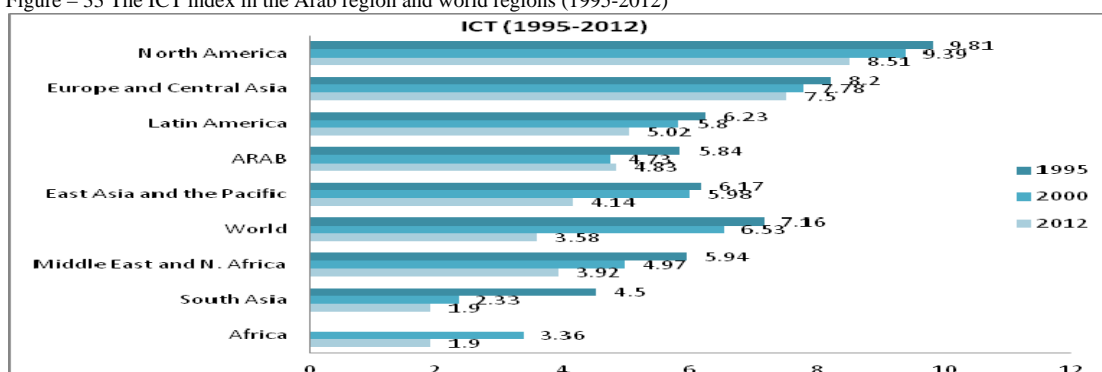
Source: Adapted from the World Bank (2012)

Figure- 32 The Education index in the Arab region and world regions (1995-2012)



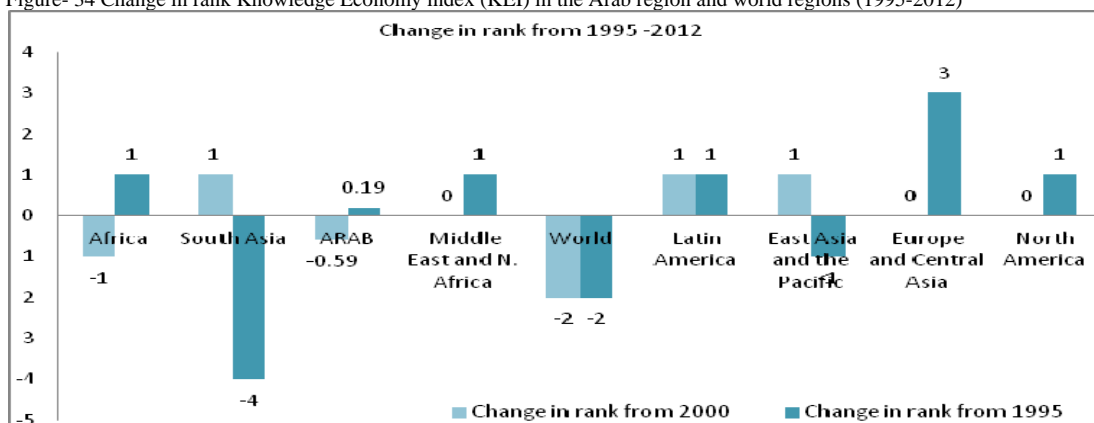
Source: Adapted from the World Bank (2012)

Figure – 33 The ICT index in the Arab region and world regions (1995-2012)



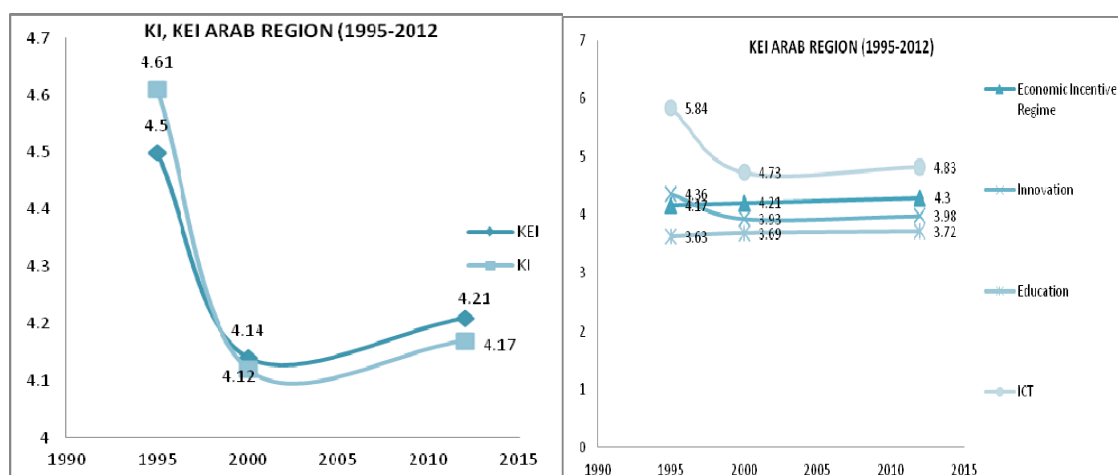
Source: Adapted from the World Bank (2012)

Figure- 34 Change in rank Knowledge Economy index (KEI) in the Arab region and world regions (1995-2012)



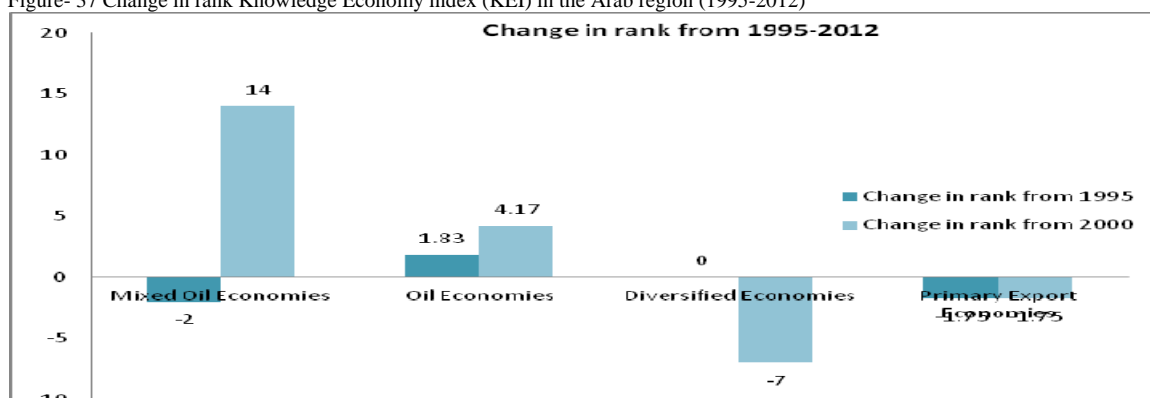
Source: Adapted from the World Bank (2012)

Figures – 35- 36-The Knowledge index (KI) and Knowledge Economy index (KEI) in the Arab region (1995-2012)



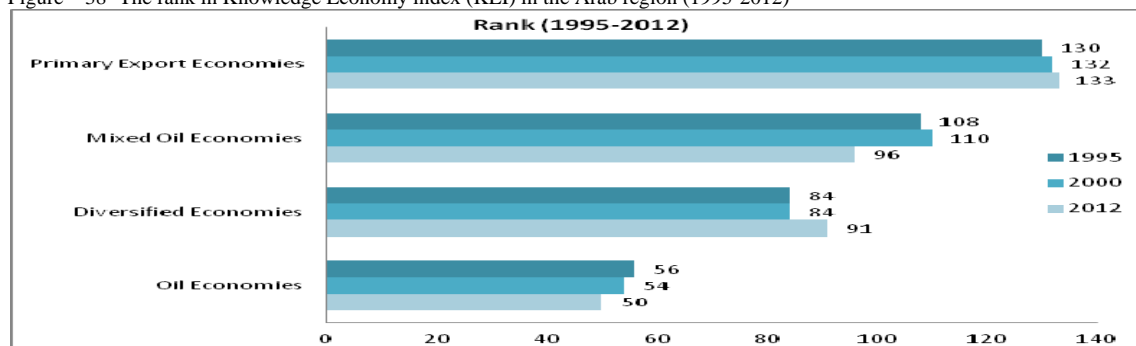
Source: Adapted from the World Bank (2012)

Figure- 37 Change in rank Knowledge Economy index (KEI) in the Arab region (1995-2012)



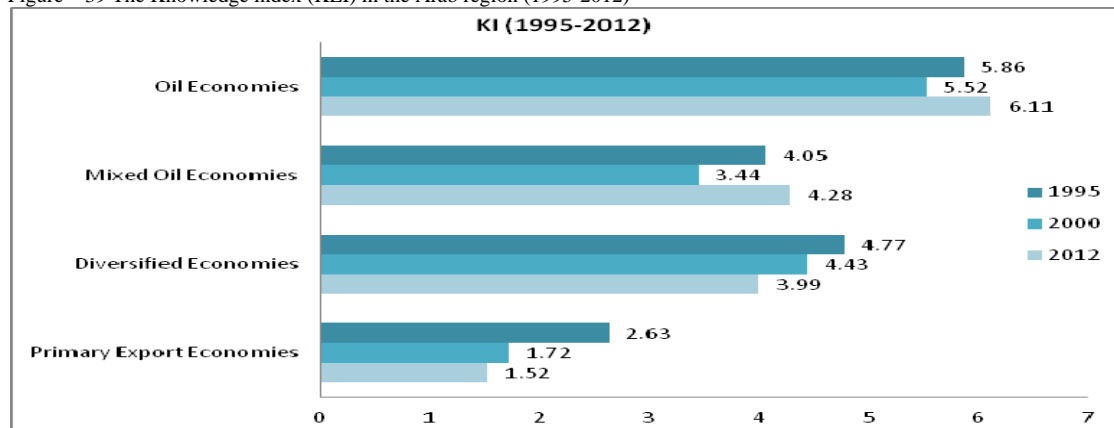
Source: Adapted from the World Bank (2012)

Figure – 38- The rank in Knowledge Economy index (KEI) in the Arab region (1995-2012)



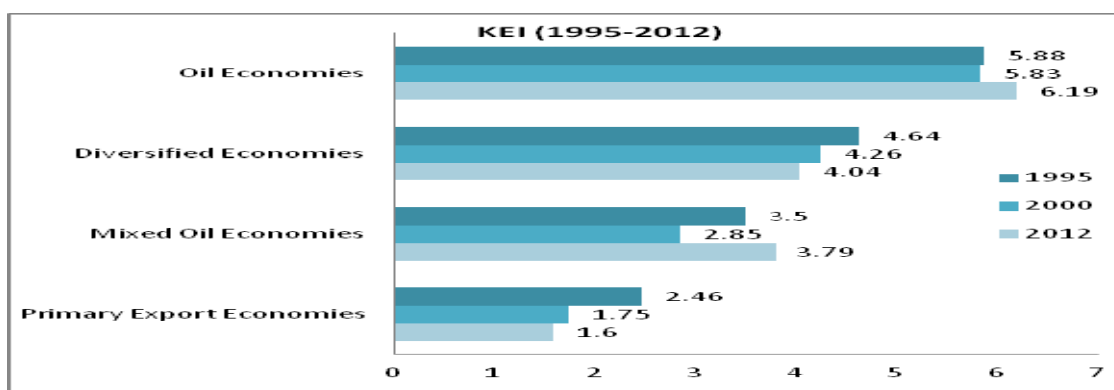
Source: Adapted from the World Bank (2012)

Figure – 39 The Knowledge index (KEI) in the Arab region (1995-2012)



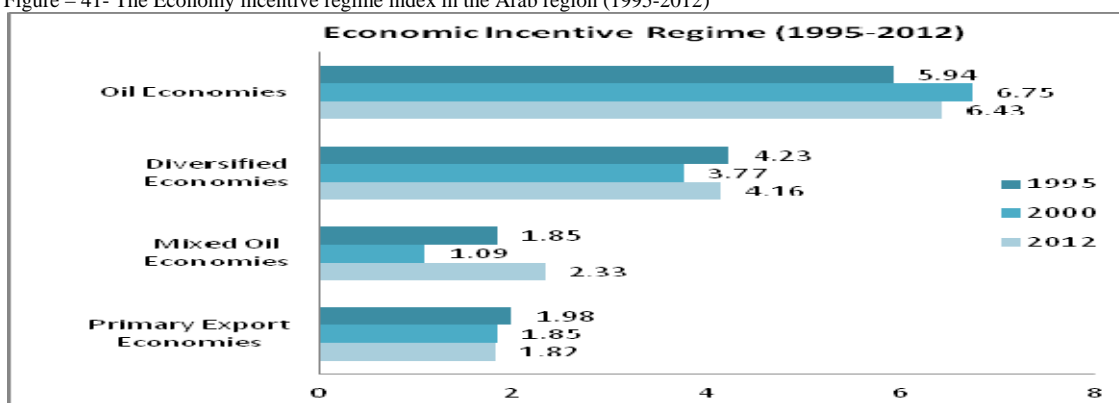
Source: Adapted from the World Bank (2012)

Figure – 40- The Knowledge Economy index (KEI) in the Arab region (1995-2012)



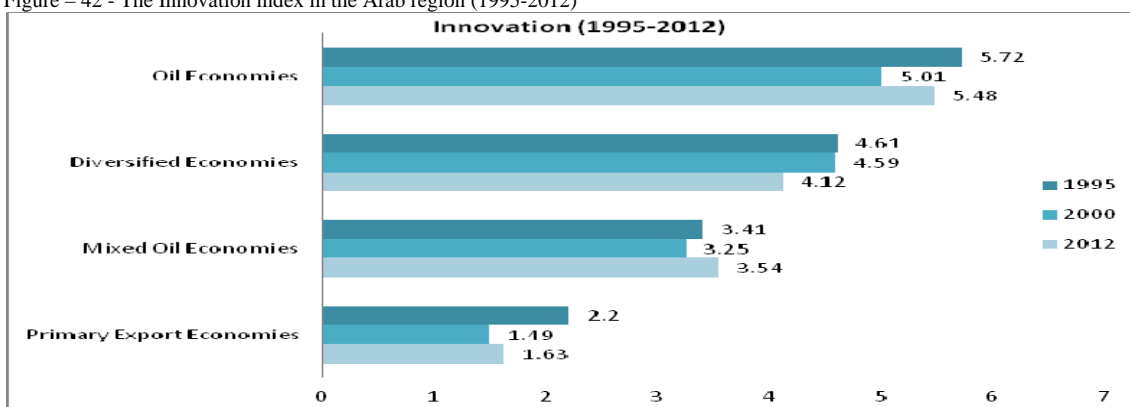
Source: Adapted from the World Bank (2012)

Figure – 41- The Economy incentive regime index in the Arab region (1995-2012)



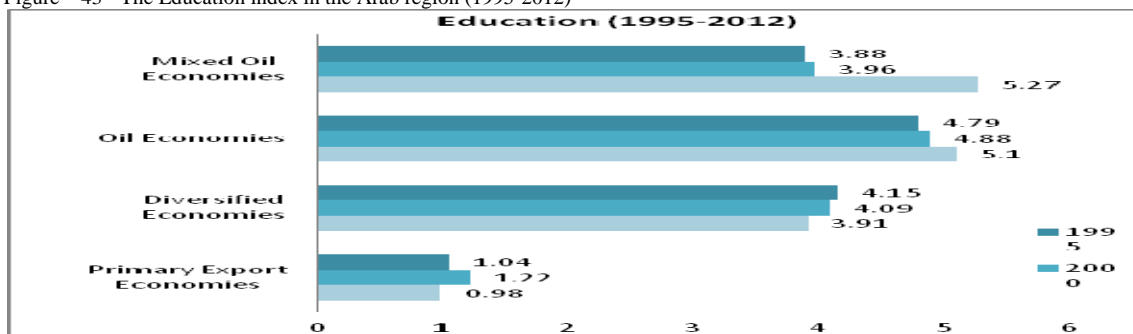
Source: Adapted from the World Bank (2012) accessed on October 10, 2012

Figure – 42 - The Innovation index in the Arab region (1995-2012)



Source: Adapted from the World Bank (2012)

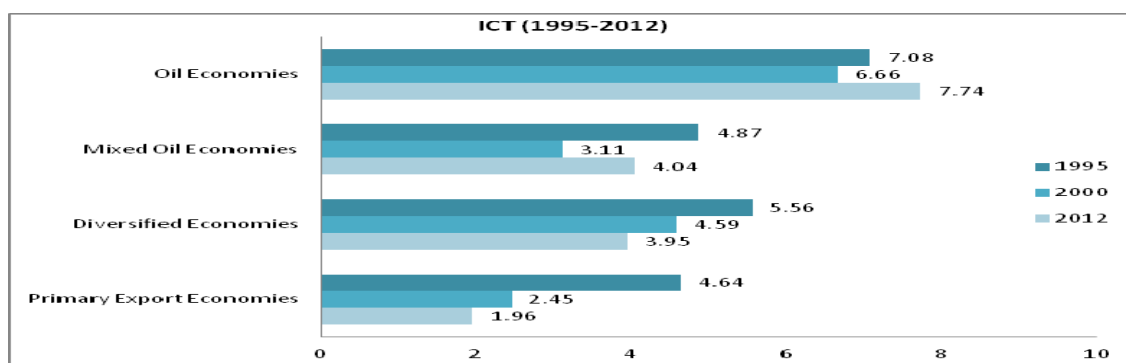
Figure – 43 - The Education index in the Arab region (1995-2012)



Source: Adapted from the World Bank (2012)

Figure – 44 - The ICT index in the Arab region (1995-2012)





Source: Adapted from the World Bank (2012)

Therefore, our findings in this section support the first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions. Our results corroborate the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region and support the third hypotheses concerning the poor and slow progress in the trend of the knowledge – related indicators in the Arab region.

## 5. Conclusions:

In this paper we present an overview of knowledge economy in the Arab region and contribute to recently published research studies that aim to improve understanding of the development and performance of knowledge economy in the developing countries. This paper addresses three following questions and examines three hypotheses.

This paper employs both the descriptive and comparative approaches and uses the definition of knowledge and knowledge indicators used in the literature to examine the existence and development of the knowledge economy in the Arab region. We fill the gap in the Arab literature and present a more comprehensive analysis of the development of knowledge indicators in the Arab region. Different from the conventional view in the literature that use the conventional classification of countries according to income level, an interesting element in our analysis is that we use a different classification by the structure of the economy to examine the knowledge economy in the Arab region.

Our findings in this paper support the first hypothesis that the knowledge economy exists in the Arab region and coincides with substantial knowledge gap compared to other world regions. Our results corroborate the second hypothesis concerning the variation in knowledge indicators according to the structure of the economy in the Arab region and support the third hypotheses concerning the poor and slow progress in the trend of the knowledge - related indicators in the Arab region.

Therefore, it is important for the Arab region to bridge the knowledge gap with other world regions. Mainly it is important for the Arab region to improve the investment in knowledge-related indicators, mainly, tacit and codified sources of knowledge. It is also important for the Arab region to improve Knowledge Economy Index (KEI) and Knowledge Index (KI) and all four pillars related to the knowledge economy - economic incentive and institutional regime, education and human resources, the innovation system and ICT.

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